(12) AUSTRALIAN PATENT ABSTRACT

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(54) NET-REINFORCED LAMINATES

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(57) Claim

1. A multiple-layer, reinforced laminate produced by heat bonding and pressure sealing, a composite comprising: a reinforcing network layer of interconnecting thermoplastic strands sandwiched between layers of outer material, the strands being comprised of an inner reinforcing core of a first polymer carrying an outer adhesive layer of a heat-sealable type.

MULTIPLE-LAYER REINFORCED LAMINATE

Background of the Invention

This invention relates to laminated sheet product reinforced with composite plastic strands carrying a layer or coating (complete, partial or segmented) of heat sealable adhesive material, preferably a thermoplastic polymer, and to a process for the preparation thereof. The strands are sandwiched between layers of outer covering material which may be plastic film; foil e.g., aluminum foil; paper e.g., filled or coated paper, Kraft paper, tissue paper (various plys) or various absorbent sheet-like materials. In its preferred form, the invention provides improved reinforced absorbent toweling.

The plastic strands used to reinforce the product are comprised of a core polymer of relatively high strength e.g., polypropylene or polyester. The strands carry a layer or coating of heat sealable adhesive material, such as a polymer, which at least partially covers the strands. Preferably, the strands are prepared by co-extruding or tri-extruding the composite material in a special extrusion die. The strands may be arranged in any form of reinforcing web as has been used heretofore in this art. However, it is most preferred if they are extruded in the form of plastic netting.

The invention will be described in specific detail hereinbelow with reference to its most preferred embodiment of continuous absorbent toweling comprised of multi-ply tissue reinforced with continuous tri-extruded plastic netting. The netting is sandwiched between the paper and, by means of heat bonding and pressure sealing, the toweling is prepared in a laminated sheet form.

The continuous extrusion of plastic net started in about 1956 with the process described in the Mercer U.S. Patent 2,919,467. Since that time, many patents have issued in the United States as well as in other countries

obvious that the spacing between strands and strand diameter may be varied as desired.

When a tube of net is extruded, it is usually drawn over a cylindrical mandrel which may stretch the strands and enlarge the openings in the net structure. Such stretching of the strands over the mandrel preferentially orients the plastic but in practice the net is characterized as being "unoriented".

For many applications, it is desirable to further stretch the net strands and more fully orient the plastic and this may be done, where as in the case of a tube of extruded net, the tube is heated and stretched longitudinally to further elongate and orient the strands. Stretching the tube causes it to collapse while the tube is being stretched longitudinally. If the tube has been slit and formed into a flat sheet of extruded net, the flat sheet may be heated and one set of strands may be stretched and oriented in one direction, and in a second separate step, the second set of strands may be stretched to orient the strands in a second direction. Some plastic net may be oriented at room temperature but as a practical matter the net is heated to speed up and facilitate orientation of the net.

Summary of the Invention

It has been unexpectedly found that individual interconnecting strands extruded to form net-like structures can be co-extruded, even under shear conditions, in the form of composite laminar strands. Laminar flow of a plurality of polymers from a co-extrusion die to form individual strands has been found, contrary to expectation, to result in an extruded composite strand which exhibits a laminar structure. It was fully expected that extrusion of laminar flow through the relatively small strand orifices of the die, coupled with the mechanical shear action to which the flow is subjected when forming interconnecting

understood by reference to the following description and the drawings in which:

Fig. 1 is an elevational cross section on the vertical axis of a portionof an extrusion die;

Fig. 2 is an enlarged fragmentary detail of part of the extrusion die of Fig. 1 taken in the area marked 2 in Fig. 1;

Fig. 3 is a pictorial view of the preferred product, a tubular extruded net, with a small part of the netting cut on the longitudinal axis to illustrate how the tubular netting may be cut and made to open up into a flat sheet of netting;

Fig. 4 is a fragmentary view of a small portion of the flattened netting described in Fig. 3 in enlarged scale;

Fig. 5 is a sectional view of a strand of the netting taken along line 5-5 of Fig. 4 and greatly enlarged;

Fig. 6 is a fragmentary to plan view of the die head plate of the extrusion die head only;

Fig. 7 is a fragmentary section in enlarged detail of part of Fig. 1 taken in the area marked 7 of Fig. 1 with the die striker in a lowered position;

Fig. 8 is a fragmentary view similar to that of Fig. 7 but with the striker in a raised position, and

Fig. 9 is a pictorial view of the sheet product of the invention.

Detailed Description of the Invention

Generally, in accordance with a preferred embodiment of the invention, plastic machine-direction strands are continuously extruded through a plurality of spaced orifice openings which are annularly disposed about an extrusion die head. An adjacent continuous orifice extending annularly about the die head is alternately covered and uncovered so as to provide, each time it is

respectively, which come together in annular reservoir 24 in a three-layer laminar flow pattern which exits from reservoir 24 into a common annular feed channel 26. This is best seen in Fig. 2 which shows three laminar layers of flowing polymer 18a, 20a and 22a. The three-layers flow past the die lips, generally indicated at 28, to form composite three-layer strands in an interconnecting network which provides a tubular net-like structure 50 shown in Figures 1 and 3.

For the purpose of extruding machine-direction strands 30 and transverse direction strands 32, lips 28 of the die are preferably formed as shown and include on the upper die head plate surface 14 a series of raised and spaced lands 34, best seen in Figure 6, which form therebetween a series of annularly positioned lower die orifices 36 through which the machine-direction strands 30 are continuously extruded from the die.

As can be seen best in Figure 1, lands 34 on die head plate 14 are spaced from portion 38 of die 10 so as to provide an upper passage 40 above the lands in the form of a continuous annular orifice which extends around the die. Associated with upper die passage 40 is a reciprocable striker 42 which may be alternately lowered and raised by a suitable means indicated at 44 to cover and uncover upper passage 40 (shown uncovered in Fig. 1). Striker 42 contacts the upper surface of lands 31 on its downward stroke.

When striker 42 is in the lower position (best seen in Fig. 7), passage 40 is closed and only the continous extrusion of machine-direction strands 30 occurs through lower orifices 36 which remain open at all times to continuously extrude the spaced plurality of machine-direction strands 30 in annularly distributed pattern as shown in Figures 1 and 3. When striker 42 is raised to its upper position (best seen in Fig. 8), passage 40 is uncovered to allow the extrusion of an annular transverse-

invention, the outer polymer layers 18a and 22a may be relatively stable, heat-sealable type adhesive polymers and other heat-sealable adhesive materials which may be chosen from the group of adhesive resins and the like. These materials when in polymeric form are of the type which have a softening temperature lower than that of the core polymer and include for example ethylene-methyl acrylate copolymer (EMA), ethylene-vinyl acetate copolymer (EVA) and thermoplastic polyvinylchlorides, polyamides. In other forms they may include hot melt adhesives, ionomer resins such as Surlyn®, marketed by E.I. DuPont de Nemours Co., thermoplastic rubbers such as Kraton®, marketed by Shell Chemical Co., Houston, Texas, and the like. The term "polymer" is used herein in the general sense to include copolymers. A most preferred resin polymer is ethylene-methyl acrylate copolymer (EMA).

The core polymer material 20a may be chosen from those polymers which are generally described herein as being of the high-strength polymers and may be chosen from the group consisting of for example, polypropylene, polyethylene, polybutylene, polyesters, nylons and the like.

It will be appreciated that the invention is not limited to the aforementioned groups of materials and that there exists a considerable number of polymers, copolymers, and the like which will fall into the core category and the heat-sealable adhesive category, relatively speaking.

In the tri-extruded form, a most preferred combination comprises a core layer 20a of polypropylene while the two outer layers 18a and 22a comprise ethylene-methyl acrylate copolymer (EMA) or ethylene-vinyl acetate copolymer (EVA), the former being most preferred. This particular combination of materials, when biaxially oriented, provides an excellent tri-extruded reinforcement material useful for tissue and other sheet product reinforcement when sandwiched between two layers of outer fabric such as

heat bonding and pressure sealing.

Example 2

Tri-extruded netting of polypropylene with DuPont EVA #3175 and Scott tissue stock as described above in two-ply. Hot roll temperature 200°-250°F.

Example 3

Tri-extruded netting of polypropylene with DuPont EVA #3190 and Scott tissue stock as described above in two-ply. Hot roll temperature 200°-250°F.

Example 4

Tri-extruded netting of polypropylene and Gulf Oil Chemicals EMA 2205. Hot roll temperature 220°-250°F.

Peel Tests

The peel test data provided herein was obtained by separating the layers of the test laminate and measuring the force required to accomplish separation. The force is measured in grams and reported below as normalized for strand count and weight of adhesive coating for comparison purposes.

Example 1	Example 2	Example 3	Example 4
172*	81*	98*	139*

*grams/strand/pounds of resin/1,000 sq. ft.

These peel tests compare very favorably to absorbent toweling prepared in the standard fashion using similar paper, latex adhesive and ordinary single layer plastic netting reinforcement which, when peel tested, provides a 10 grams/strand/pound of resin/1,000 sq. ft. as a typical result.

It will be understood that the claims are intended to cover all changes and modifications of the preferred embodiments of the invention herein chosen for the purpose of illustration.

8. The laminate of claim 1 in which the core polymer comprises polypropylene.

9. The laminate of claim 1 in which the outer adhesive layer is ethylene methyl acrylate copolymer (EMA).

10. The laminate of claim 1 in which the core polymer comprises polypropylene and the outer adhesive layer is ethylene methyl acrylate copolymer (EMA).

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